PLANT ITEM MATERIAL SELECTION DATA SHEET

HOP-HEME-00001A/B & 2A/B (HLW)
Melter 1 & 2 High Efficiency Mist Eliminator (HEME)

- Design Temperature (°F)(max/min): 325/32
- Design Pressure (psig) (max/min): 15/FV
- Location: incell

ISSUED BY
RPP-WTP PDC
INIT | DATE

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on Sheet 5

Operating Modes Considered:

- The vessel is at pH < 2.5 at the normal operating temperature
- The vessel is at pH < 2.5 at boiling, ≈212°F
- The vessel cycles between wet conditions at 111°F and dry at 325°F

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N08367

Recommended Corrosion Allowance: 0.04 inch

Process & Operations Limitations:

- Develop a rinse/flush strategy
- Develop a lay-up procedure

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
4/22/04
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 5 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
0	4/22/04	Issued for Permitting Use			

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

a General Corrosion
Hamner (1981) lists corrosion rates for 304 (and 304L) and 316 (and 316L) of less than about 1 mpy in dilute neutral salt solutions.

Conclusion:
The 300 series alloys are acceptable.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. Normally the vessel is to operate at 111°F at a pH < 2.5. Berhardsson et al (1981) conclude 304L could be used, although 316L would provide additional safety. However, if the temperature can exceed 150°F, Phull et al (2000) imply that a 6% Mo alloy or the equivalent will be better even though the nominal halide concentrations are low. Allowing that the temperature can approach the design temperature and the vessel can cycle between wet and dry conditions, a more resistant alloy is required.

The presence of Hg in the waste stream suggests a 6% Mo with a low Cu content, such as AL6XN (UNS N08367), is preferred.

Conclusion:
A 6% Mo alloy is recommended.

c End Grain Corrosion
End grain corrosion only occurs in high acid conditions.

Conclusion:
Not expected in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, the environment, and also because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. The expected concentrations, about 1 ppm, at ambient temperature would not require anything more than 304L. However with the stated operating temperature, 316L is recommended. Because the HEME can be acid and cycle to dryness, a minimum of 6% Mo is recommended.

Conclusion:
With the stated conditions, a 6% Mo is recommended.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Weld corrosion is not expected to be a concern if proper welding procedures are followed.

Conclusion:
Not a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are ideal for microbial growth – however food sources and sources of microbes are effectively non-existent.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue not a problem because the 6% Mo alloy is sufficiently resistant for expected temperature cycles.

Conclusions
Not expected to be a concern

i Vapor Phase Corrosion
The vapor phase portion of the vessel is expected to be contacted with particles of waste from splashing. It is uncertain whether the region will be sufficiently washed to prevent solids deposits. A more pitting-resistant alloy such as a 6% Mo is recommended

Conclusion:
6% Mo alloy is recommended.

j Erosion
Velocities within the vessel are not expected to be a concern.

Conclusion:
Not expected to be a concern

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No metal/metal contacting surfaces expected.

Conclusion:
Not a concern.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not a concern.

n Cavitation
None expected.

Conclusion:
Not a concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Berhardsson, S, R Mellstrom, and J Oredsson, 1981, *Properties of Two Highly corrosion Resistant Duplex Stainless Steels*, Paper 124, presented at Corrosion 81, NACE International, Houston, TX 77218
2. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
3. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.

Bibliography:

1. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
4. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
5. Miles RE, 2001, Telecon to JR Divine, *LAW and HLW Gamma Radiation Exposures Estimates*, RPP-WTP, Richland, WA 99352
6. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
7. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
8. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084
9. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho National Engineering Laboratory, Idaho Falls, ID

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

Material Selection Data Sheets for the HLW Vitrification Facility

Materials Selection Data

Component (Name/ID) High Efficiency Mist Eliminator HOP-HEME-00001A/B & 2A/B
System HLW-HOP

Operations

Chemicals	Unit	Cold Startup	Normal Operations	Contract Max.	Cleaning	Accident
		Note 1		Note 2	Note 3	Note 4
Aluminum	g/l		0.003			
Chloride	g/l		0.015			
Fluoride	g/l		0.015	1.1		
Iron	g/l					
Nitrate	g/l		0.0011			
Nitrite	g/l		0.0003			
Phosphate	g/l					
TOC†	g/l		0			
Sulfate	g/l		0.0003			
Undissolved solids	g/l		0.086			
Particle size/hardness	µm (##)					
Other ($NaMnO_4$, Hg, etc)	g/l		0.14	1.79 (Hg^{++})		
Carbonate	g/l		0			
pH	-		≤ 2.5			
Dose rate, α, β/γ	Rad					
Temperature	°F		111.2			
Velocity	fps					
Vibration						
Time of exposure	#					

- % of total; ## - use Mho scale

Notes:
Note 1: Same as normal operation.
Note 2: Max. contract value mass balance, unreleased. Only values greater than normal operations are listed.
Note 3: H2O or $\leq$ 12.2M Nitric Acid for cleaning for 1 week for 5 yr for acid and 1 hr per year for water. Solids are accumulated the same as those entering column dried on the HEME element.
Note 4: Assume same as normal operating conditions.

☐ Black Cell

☐ Flushing

† List expected organic species: __________
Use maximum of 2 significant figures